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ANTINEURITIC VITAMINE IN SKIM MILK POWDER.

By J. M. JOHNSON, Chemist, and C. W. HOOPER, Pathologic Physiologist, Division of Pharmacology, Hygienic Laboratory, United States Public Health Service.

Reconstructed milk has recently come into use in localities where an ample supply of fresh milk is not available. This milk is made from skim milk powder, butter fat, and water, mixed in the proportions necessary to re-form liquid milk. The mixing is carried out in a specially designed machine, so that a separation of the butter fat takes place only upon long standing. It became necessary to decide whether skim milk powder used in making reconstructed milk retains its water-soluble vitamine (B) content or whether this is destroyed by the process of drying. We have, therefore, attempted to determine the amount of skim milk powder necessary to prevent polyneuritis in pigeons.

Vedder and Clark¹ found that 5 c. c. daily of fresh cow's milk or 5 c. c. of canned milk did not prevent polyneuritis in fowls. E. A. Cooper² fed fresh milk to pigeons and found that 35 c. c. daily only delayed the onset of polyneuritis until the fiftieth day. Protection was not secured by this amount. Gibson and Concepción³ found that the minimum protective amount of liquid cow's milk for fowls is between 100 and 200 c. c. daily. They concluded that milk contains such a small amount of antineuritic substance that care should be used to extend the diet of infants as early as possible. They did not find any advantage of raw milk over autoclaved milk in this respect.

EXPERIMENTAL.

Skim milk powder made by the spray process was used. The polished rice was picked over by hand and all incompletely polished grains were carefully removed. The rice was then ground in a small mill and mixed in varying proportions with the skim milk powder. A small amount of water was added to make a sticky dough. This was dried out under the electric fan and broken into small pieces. The pigeons ate this food very readily.

The table shows the results obtained from the feeding of rice and various percentages of skim milk powder. All of the 6 control pigeons fed on 100 per cent rice developed symptoms of polyneuritis and

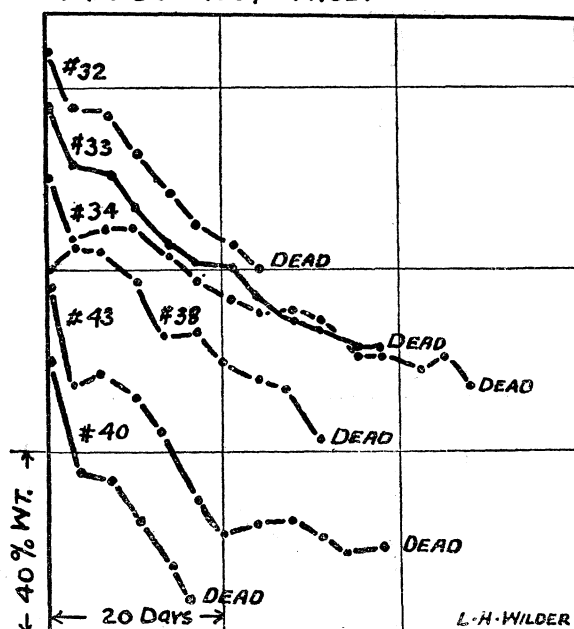
¹ Philippine Jour. Sci. VII, B, 423 (1912).

² Jour. Hyg. XIV, 12 (1914).

³ Philippine Jour. Sci. XI, B, 119 (1916).

died within 48 days. Histological examination of their sciatic nerves showed the presence of fatty degeneration. Of 7 pigeons fed on a diet composed of 80 per cent rice and 20 per cent skim milk powder, 5 showed fatty degeneration of the sciatic nerve and 1 showed a normal nerve; the seventh bird escaped, but had shown no symptoms of polyneuritis after 139 days. The onset of polyneuritis in 1 case of the 5 cases was delayed until the one hundred and twenty-eighth day. Of 4 pigeons fed on a diet composed of 75 per cent rice and 25 per cent skim milk powder, 3 showed fatty degeneration of the sciatic nerve and 1 a normal nerve. However, the onset of polyneuritis was delayed in the 3 cases from 57 to 82 days. Of 16 pigeons fed on diets

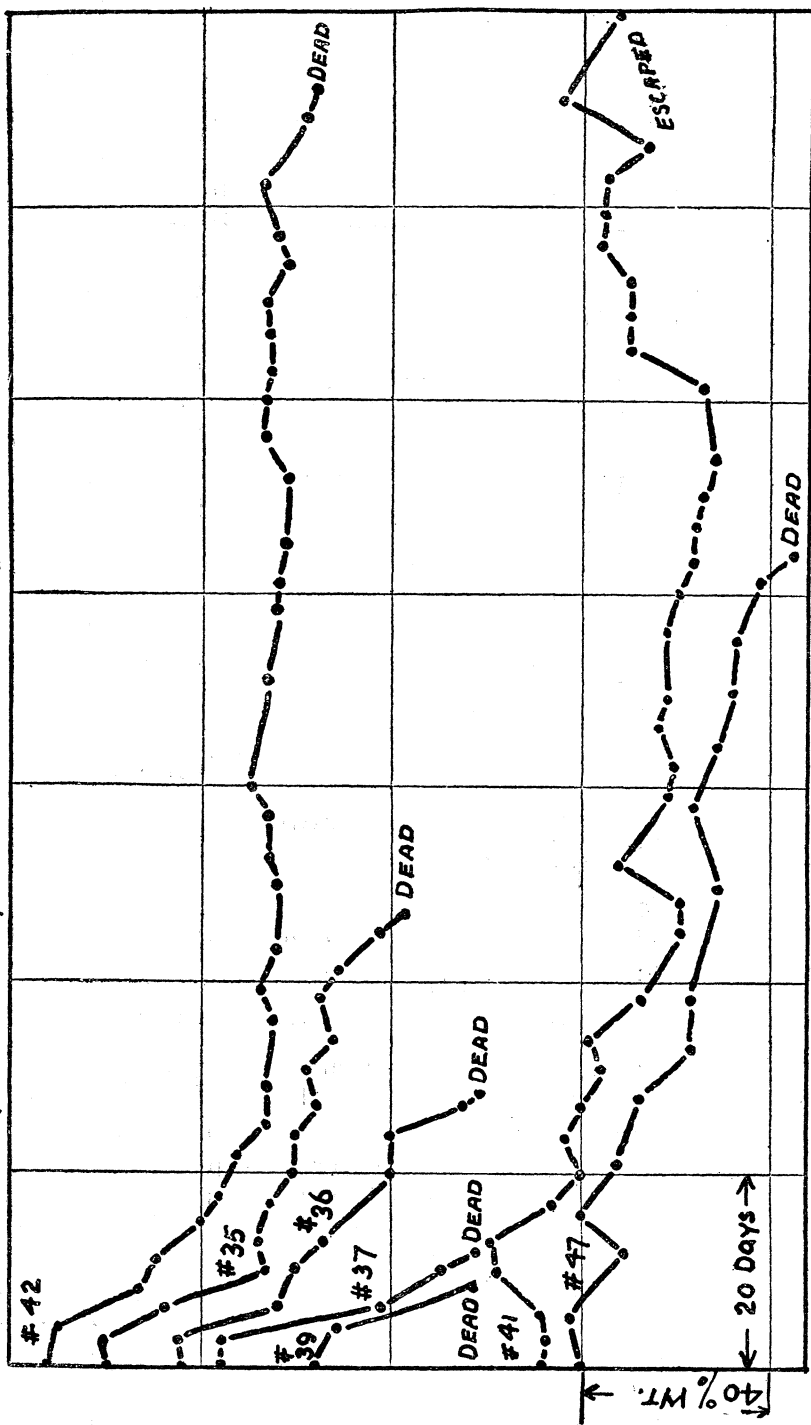
CHART 1:— 100% Rice.



composed of 30–100 per cent skim milk powder and 70–0 per cent rice all showed normal sciatic nerves. However, in 3 cases, symptoms of polyneuritis with subsequent recovery were observed.

An examination of the table will show that in order to secure complete protection from polyneuritis the skim milk powder must constitute at least 30 per cent of the diet. A diet containing 25 per cent skim milk powder will delay the development of polyneuritis but will not protect against it. Even 20 per cent skim milk powder delayed the onset in a few cases. The pigeons consumed about 20–25 grams daily of the mixture of skim milk powder and rice. Therefore it requires about 6–7 grams daily of skim milk powder to protect from polyneuritis. This corresponds to about 75 c. c. of liquid milk.

CHART 2:- 80 % RICE - 20 % SKIM MILK POWDER.

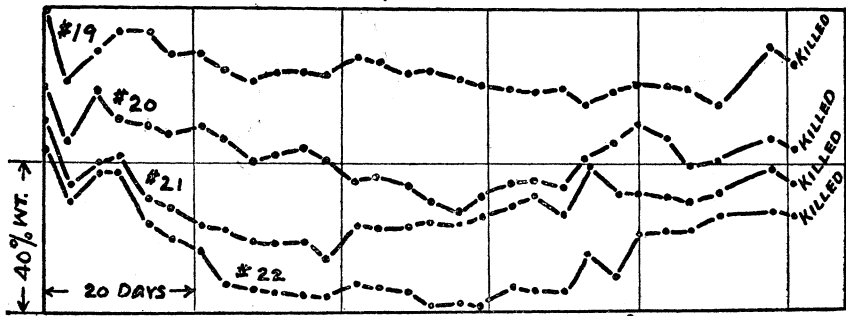


Results of experimental feeding of pigeons.

Pigeon No.	Food.		Symptoms of polyneuritis.	Length of life.	Termination.	Sciatic nerve.
	Per cent rice.	Per cent skim milk powder.				
32	100	.....	After 16 days.....	<i>Days.</i> 24	Died....	Extensive fatty degeneration (Marchi).
33	100	.....	After 31 days.....	37	do....	Do.
34	100	.....	After 32 days.....	48	do....	Do.
38	100	.....	After 24 days.....	31	do....	Do.
43	100	.....	After 14 days.....	16	do....	Do.
40	100	.....	After 39 days.....	41	do....	Definite fatty degeneration (Marchi)
42	80	20	After 128 days.....	130	do....	Do.
35	80	20	After 27 days.....	46	do....	Moderate fatty degeneration (Marchi).
36	80	20	After 24 days.....	28	do....	Do.
37	80	20	Emaciated by tenth day.	12	do....	Definite fatty degeneration (Marchi).
39	80	20	None.....	7	do....	Normal.
41	80	20	do.....	139	Escaped	
47	80	20	After 81 days.....	84	Died....	Definite fatty degeneration (Marchi).
44	75	25	After 121 days; recovery.	187	Killed...	Normal.
45	75	25	Emaciated after 60 days.	99	Died....	Moderate fatty degeneration (Marchi).
46	75	25	After 57 days.....	65	do....	Definite fatty degeneration (Marchi).
48	75	25	After 82 days.....	84	do....	Extensive fatty degeneration (Marchi).
19	70	30	None.....	102	Killed...	Normal.
20	70	30	do.....	102	do....	Do.
21	70	30	do.....	102	do....	Do.
22	70	30	After 32 days; recovery.	102	do....	Do.
23	60	40	None.....	102	do....	Do.
24	60	40	do.....	102	do....	Do.
25	60	40	do.....	101	do....	Do.
26	50	50	do.....	101	do....	Do.
27	50	50	do.....	101	do....	Do.
28	50	50	After 32 days; recovery.	101	do....	Do.
29	40	60	None.....	102	do....	Do.
30	40	60	do.....	101	do....	Do.
31	40	60	do.....	102	do....	Do.
10	0	100	do.....	83	do....	Do.
11	0	100	do.....	83	do....	Do.
12	0	100	Questionable at 42 days.	44	Died....	Do.

Since Cooper found that 35 c. c. of fresh milk delayed the development of polyneuritis only until the fiftieth day, and Gibson and

CHART 4 :- 70% RICE - 30% MILK POWDER.



Concepción found that fowls required 100-200 c. c. of fresh milk daily for protection, it appears that even fresh milk contains very little antineuritic substance. Our work shows that the amount of

this substance in skim milk powder is of the same order of magnitude as in fresh milk, and that therefore the process of drying skim milk does not lead to an appreciable destruction of the vitamine in question.

CHART 5:- 60% RICE - 40% SKIM MILK POWDER.

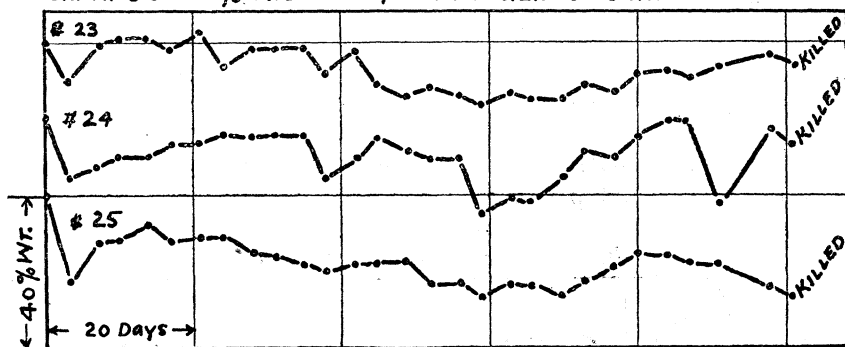


CHART 6:- 50% RICE - 50% SKIM MILK POWDER.

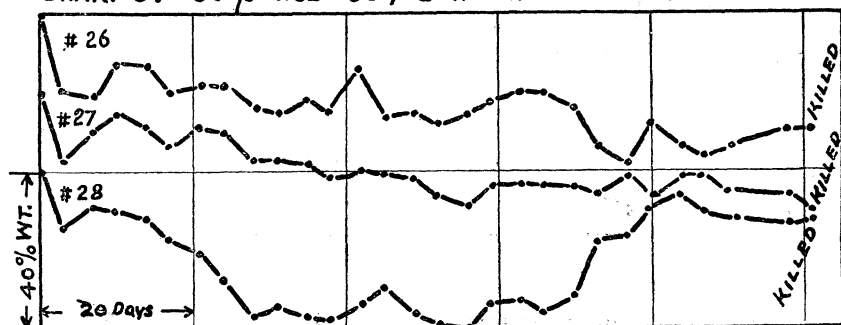
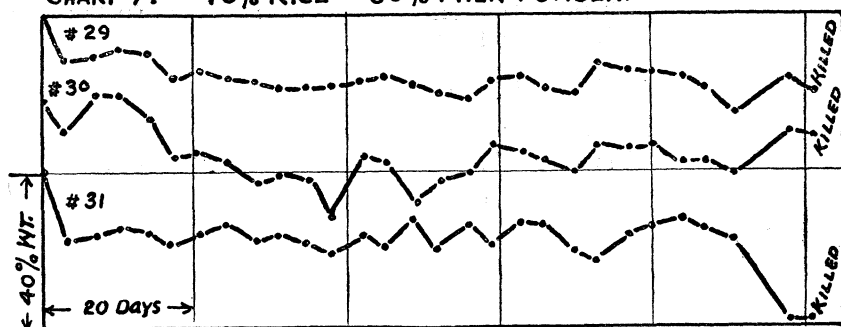


CHART 7:- 40% RICE - 60% MILK POWDER.



The feeding of rats on a purified basal ration plus milk, by Osborne and Mendel⁴ and one of the present authors,⁵ shows that a large amount of milk is required to give normal growth to albino rats. If

⁴Jour. Biol. Chem. XXXIV, 537 (1918).

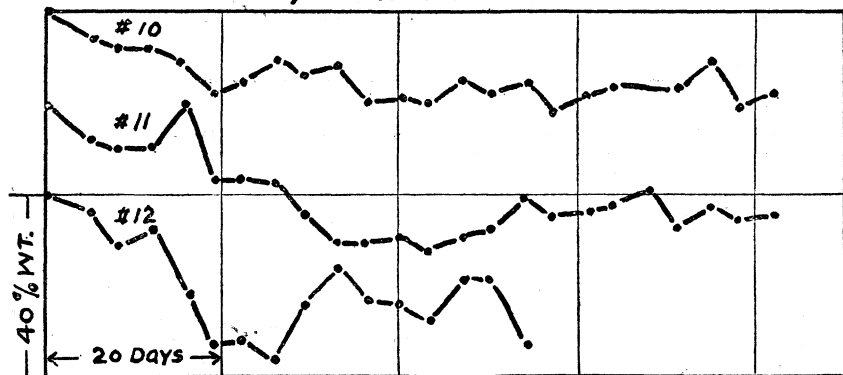
⁵J. M. Johnson, unpublished work.

we accept that the antineuritic and water-soluble vitamine are the same, we would expect to find that it required a large amount of milk to prevent polyneuritis in pigeons, an assumption which is in accord with the facts presented in this paper.

The pigeons weighed about 300 grams each. With a requirement of 6 to 7 grams daily for the pigeons, a child of 4.5 k. body weight would require 1,125 c. c. daily of reconstructed milk in order to receive an adequate amount of antineuritic substance, provided that the requirements of the two species were the same.

The charts give the picture of the weight changes of the pigeons. The curves are plotted upon the basis of per cent, starting with the initial weight as 100 per cent.

CHART 8:- 100 % SKIM MILK POWDER.



SUMMARY.

Pigeons fed upon mixtures of spray process skim milk powder with polished rice require 30 per cent of the food in skim milk powder in order to get full protection from polyneuritis. This corresponds to about 75 c. c. daily liquid milk.

ACKNOWLEDGMENTS.

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